

## PUBLIC COMMENTS TO CASAC

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**From:** Doug Blewitt, CCM (doughblewitt@comcast.net)  
**To:** CASAC  
**Date:** January 9-10, 2011  
**Subject:** Background Ozone in the Integrated Science Assessment  
**Sponsored by:** BP America Production Company

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My comments today will focus on how ozone background estimates should be used in the ozone standard setting process and determination of the averaging time of the standard.

### **Determination of Background**

In many areas of the U.S., natural or transport of international pollution events occur on a frequent basis. Ozone is unique because in some locations background (natural and international ozone) represents a large fraction of the total ozone. EPA has no regulatory ability to reduce such background impacts. If the ozone standard is reduced to the levels previously considered, analyses need to be performed to determine if the lower levels of the standard can actually be achieved. Feasibility of achieving lower ozone standards is important and merits stakeholder dialogue.

For other pollutants such as PM, background is typically associated with distant U. S. anthropogenic sources and to a lesser extent, natural emissions. The exceptions to this are windblown dust and wildfires. These events are easily identifiable, infrequent and EPA has removed such events for compliance purposes by using the exceptional events rules of 40 CFR 50.14. Thus, for other pollutants, EPA regulations have the potential for reducing background. The ability to control background concentrations is an important policy consideration.

There have been considerable improvements in the estimation of background ozone through modeling; however, many unresolved modeling issues remain. Consideration should also be given regarding how background levels are used in health risk assessments and in the overall standard setting process. Because EPA has no ability to reduce background ozone, the concentration level should become the threshold in any risk assessment.

In the past, EPA has compared average modeled background concentrations (diurnal monthly average concentrations) to total monitored concentrations. Monitored concentrations represent a range of values associated with the entire frequency distribution and comparing episodic events to an average background concentration underestimates the difference between background and total ozone. To evaluate the

importance of background concentrations, EPA needs to use the entire frequency distribution of modeled background concentrations and total ozone (measured or modeled). The comparison should be paired in time and space. By using the entire frequency distribution of modeled background, the fraction of the total ozone that is background can be determined on an event basis. Since the ozone NAAQS focuses on extreme statistics, the fraction of background compared to total ozone for the same time period has very important policy implications.

The analysis of background concentrations presented in these comments is based on modeling that excluded U.S. anthropogenic emissions and anthropogenic emissions from Canada and Mexico. If an alternate definition of background were used, (i.e., U.S. background or background based on some level of anthropogenic emissions needed to support public health), estimates of background concentrations would increase and the fraction of background relative to total ozone would also increase.

A comparison of background levels to total ozone concentrations is presented for the rural Gothic, CO CASTNet monitor and for Denver, CO. The analyses presented are based on hourly modeling results obtained from GEOS-Chem and CAMx from the Zhang and Emery peer reviewed papers.

#### **Background Analysis for Gothic, Colorado CASTNet Monitor**

Figures 1 and 2 present a scatter plot of GEOS-Chem (0.5 by 0.67 degree)<sup>1</sup> and CAMx (12 km grid)<sup>2</sup> modeled background plotted against the corresponding modeled total ozone for the Gothic, Colorado CASTNet monitoring site. The monitoring site is located in central Colorado at an elevation of 9,800 feet and is a rural monitoring location with no nearby local sources.

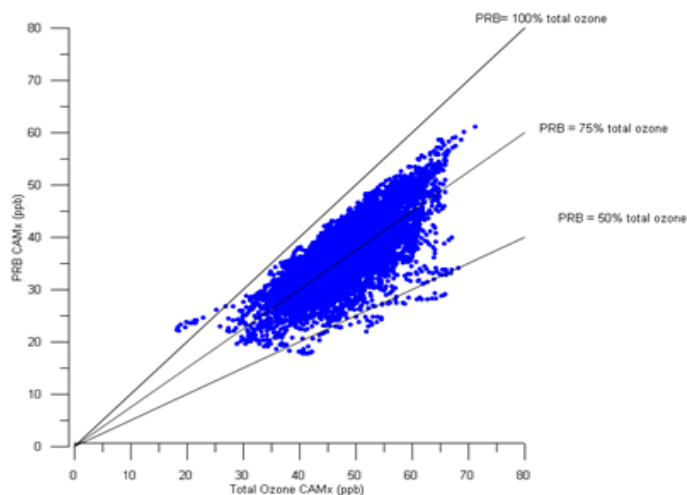
In Figures 1 and 2, the modeled estimate of background was plotted against the corresponding modeled value for total ozone<sup>3</sup>. The three diagonal lines represent where background is equal to total ozone, where background is equal to 75 percent of total ozone and where background is equal to 50 percent of total ozone.

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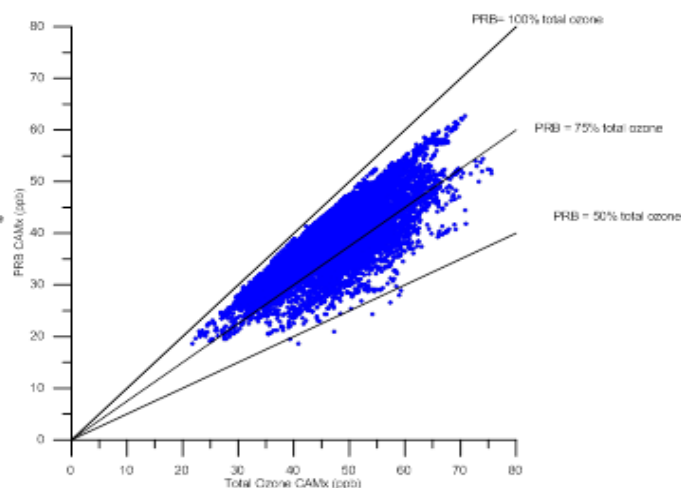
<sup>1</sup> Zhang, Lin, Daniel J. Jacob, Nicole V. Downey, Dana A. Wood, Doug Blewitt, Claire, C. Carouge, Aron van Donkelaar, Dylan B. A. Jones, Lee T. Murray, Yuxan Wang 2011, "Improved estimate of the policy-relevant background ozone in the United States using the GEOS-Chem global model with ½ degree x 2/3 degree horizontal resolution over by North America" Atmospheric Environment.

<sup>2</sup> Christopher Emery, Jaegun Jung, Nicole Downey, Jeremiah Johnson, Michele Jimenez, Greg Yarwood, Ralph Morris, 2011, "Regional and global modeling estimates of policy relevant background ozone over the United States", Atmospheric Environment.

<sup>3</sup> 1-hour averaging time



**Figure 1.** Paired in Time Background and Total Ozone, Gothic, CO  
GEOS-Chem 0.5 X 0.67 degree grid, 2006



**Figure 2.** Paired in Time Background and Total Ozone, Gothic, CO  
CAMX 12 km degree grid, 2006

These two figures indicate that for both models, background ozone is rarely less than 50 percent of total ozone on an event basis. For CAMx, the overall fraction of background is greater than for the GEOS-Chem model. This is probably related to the fact that at the 12 kilometer grid resolution, CAMx is able to simulate STE events and subsidence of upper level troposphere ozone better than GEOS-Chem which had a much larger grid size.

One other attribute of this comparison is that modeled background is compared to total modeled ozone. Thus, any bias in the models is the same for background as in total ozone. If modeled background is compared to monitored background, then any bias in the model introduces a large uncertainty in the fraction of background to total ozone. Total and background are under predicting extreme ozone events. These figures indicate the importance of comparing background ozone to total ozone for a specific event.

Concentrations of background and total ozone were greater for CAMx compared to GEOS-Chem. CAMx predicted 18 hours when total ozone was above 70 ppb. The maximum predicted total ozone concentration was 76 ppb. For the 18 hours above 70 ppb, the fraction of background to total ozone ranged from 60 to 90 percent. GEOS-Chem predicted that there was only 1 hour above 70 ppb (maximum was 71 ppb) and the fraction of background to total ozone was 86 percent.

### Background Analysis for Denver, Colorado

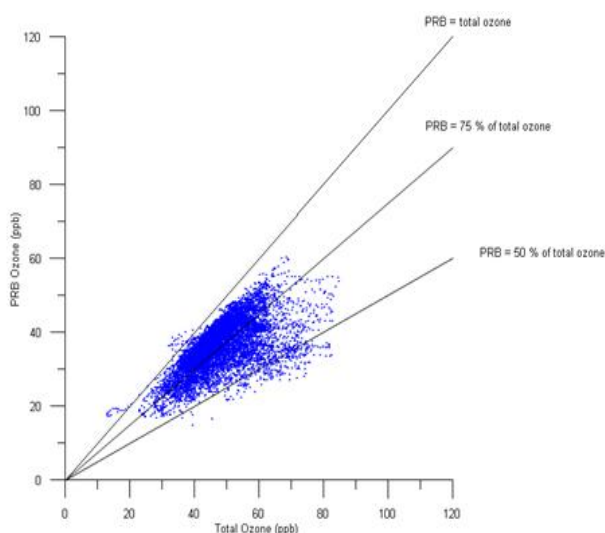
The same analysis techniques developed for examining the relationship between background and total ozone for the Gothic, Colorado CASTNet site were applied to Denver, Colorado (city center). The goal of the analysis was to evaluate the concurrent relationship between background and total ozone for both GEOS-Chem and CAMx. The analysis was performed in the same manner as at the Gothic site.

Figure 3 presents the comparison for background and total ozone for the GEOS-Chem model and Figure 4 presents the same information for CAMx. Unlike the comparison for

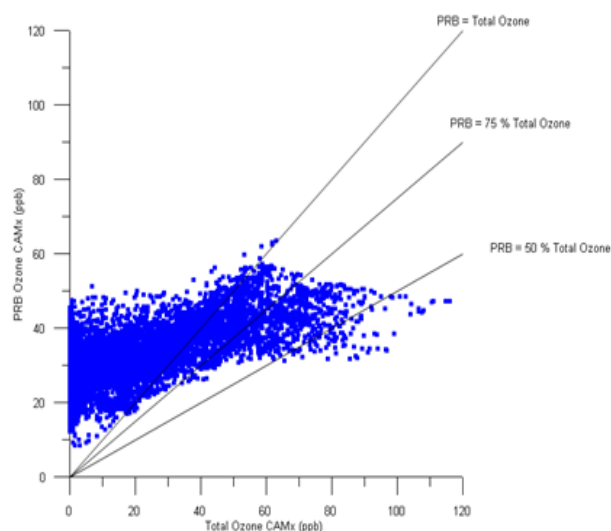
Gothic, CO there are substantial differences between the GEOS-Chem and CAMx models for paired background and total ozone.

In the case of GEOS-Chem, the majority of the background concentrations were greater than 50 percent of total ozone. Also, a large portion of the background estimates were approximately equal to total ozone. In addition, during some periods of maximum hourly ozone, the fraction of background was almost equal to total ozone. However, during periods of maximum predicted ozone, background was approximately 70 percent of total ozone. The GEOS-Chem model indicates that during maximum predicted total ozone, background ozone contributed a large fraction to total ozone.

The CAMx background and total ozone results are very different from those of the GEOS-Chem model. As shown in Figure 4, there is a large region where background concentrations are much larger than total ozone. This region exists up to a total ozone concentration of 50 ppb. The explanation for background being greater than total ozone is that in the total ozone simulation, local NO emissions were consuming O<sub>3</sub> to form NO<sub>2</sub>. The background model run does not have any local NO emissions and hence ozone impacts were greater than total ozone.



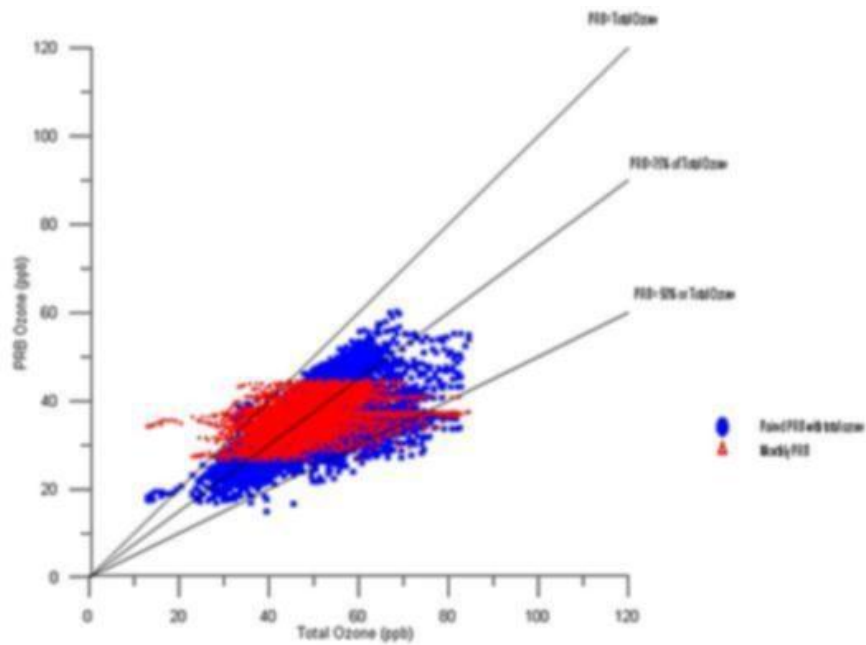
**Figure 3.** Paired in Time Background and Total Ozone, Denver, CO  
GEOS-Chem 0.5 X 0.67 degree grid, 2006



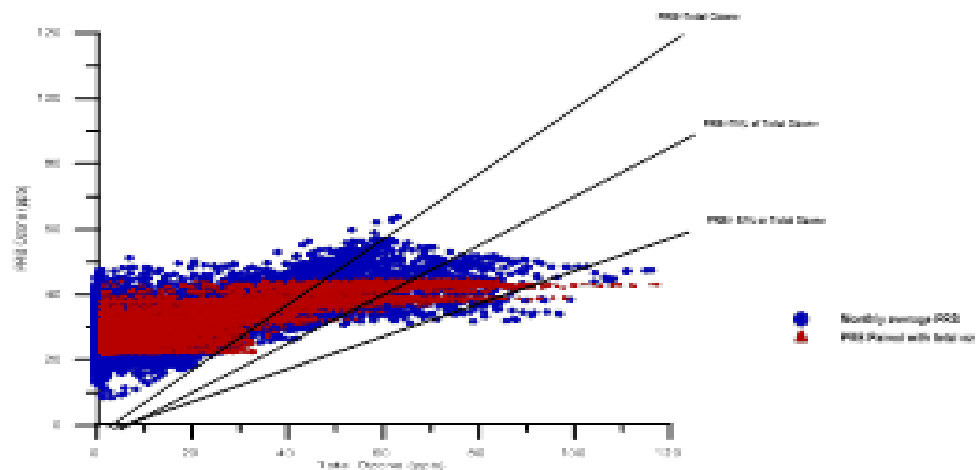
**Figure 4.** Paired in Time Background and Total Ozone, Denver, CO  
CAMX 12 km degree grid, 2006

There are several important implications to this finding. First, the background model run represents background concentrations that need to be considered in a policy and risk setting. Second, local emission controls may be ineffective because as local controls are added, background ozone will replace locally produced ozone.

EPA has previously used a diurnal monthly background profile as input to the standard setting process and risk assessment in the ISA. Figure 5 presents the difference between using a diurnal monthly profile and a paired profile for Denver.



**Figure 5.** Comparison of Paired PRB and Monthly Hourly Average PRB to Total Ozone, Denver, CO  
GEOS-Chem 0.5 X 0.67 degree grid, 2006

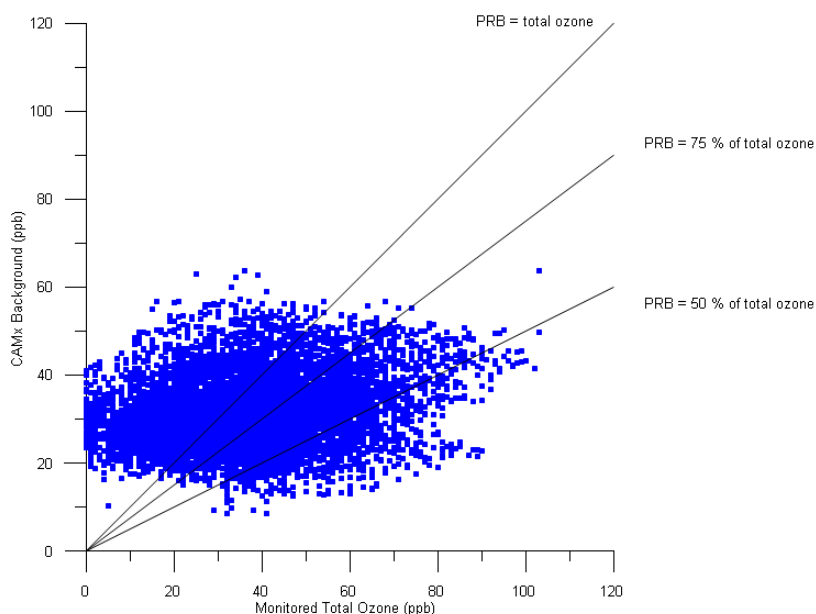


**Figure 6.** Comparison of Paired PRB and Monthly Hourly Average PRB to Total Ozone, Denver, CO  
CAMx 12 km grid, 2006

The preceding two figures indicate that by using the diurnal mean concentration for background, the relative difference between background and total ozone is substantially understated for the upper end of the frequency distribution of ozone concentrations.

In addition to examining coincident modeled background to modeled total ozone, an analysis was conducted to examine modeled background to monitored ozone. The comparison between modeled background using CAMx and monitored total ozone introduces the uncertainty of model accuracy.

Figure 7 presents modeled background concentrations (city center) compared to the suburban Chatfield, CO ozone monitor. This monitor is located away from the city center and typically experiences higher ozone levels than the CAMP monitor (city center).



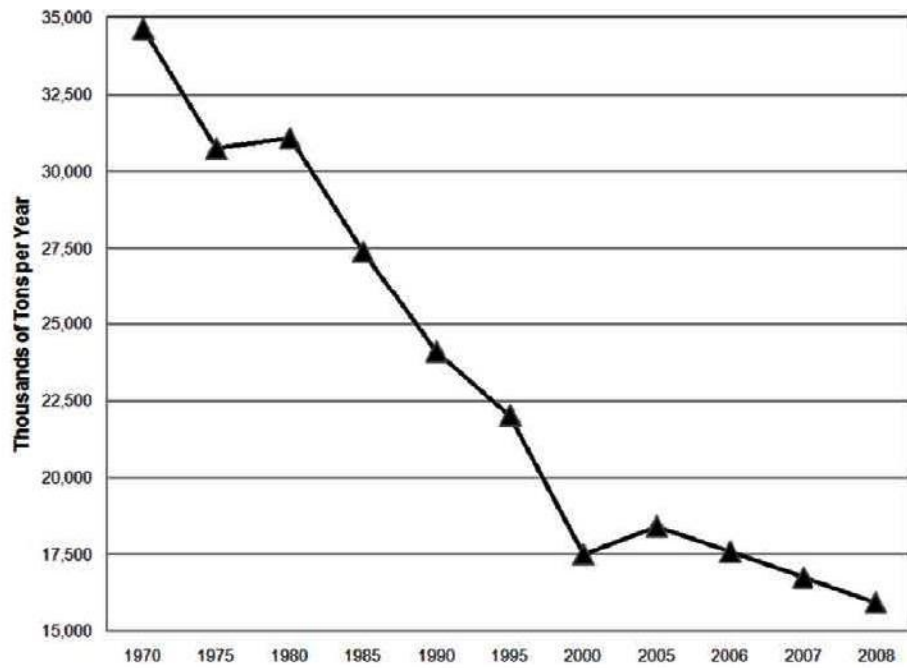
**Figure 7.** Comparison of CAMx Background with Paired Chatfield Monitor Data, Denver, CO  
CAMx 12 km grid, 2006

The relationship between coincident background and monitored total ozone is dependent on the ability of the CAMx model to replicate the monitored ozone levels.

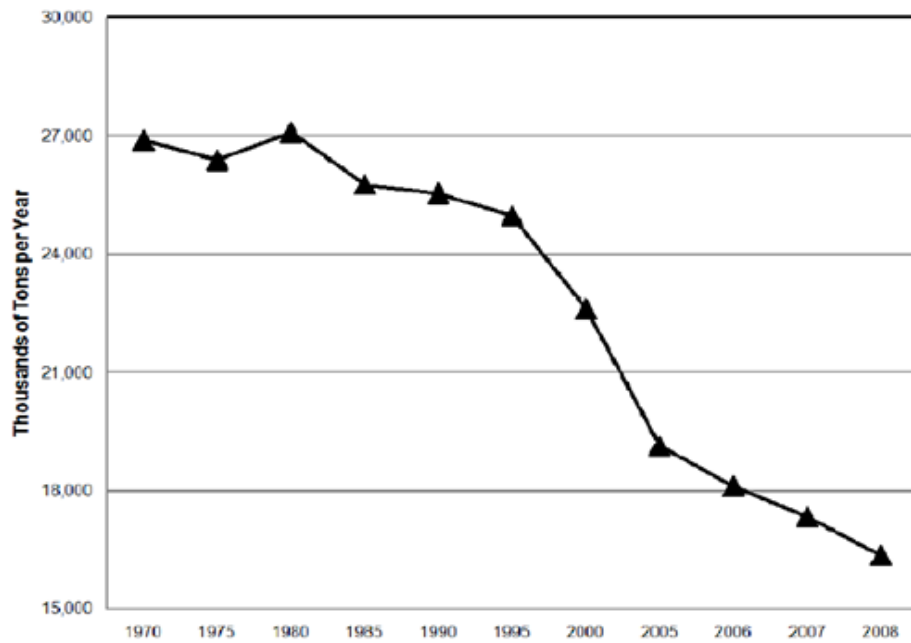
### Form of the Ozone Standard

Figures 8 and 9 present the changes in National VOC and NO<sub>x</sub> emissions over the period 1970 through 2008 and indicate that NO<sub>x</sub> and VOC emissions have been reduced by approximately 50%. While this is a national estimate, it is reasonable to assume that Colorado emission reductions were similar to the national trend. Figure 10 presents the corresponding change in both 1 hour and 8 hour monitored ozone concentrations over the time period 1975 through 2008. On average, the 1 hour ozone monitoring concentrations for this time period dropped from 0.19 ppm to approximately 0.097 ppm (a 49 percent reduction). By contrast, over the same period there is very little change in the 8 hour ozone concentrations.

The 8 hour average concentration spans both the peak ozone period and the ozone build up or depletion periods of the diurnal ozone cycle. It is very likely that NO<sub>x</sub> emission reductions result in less ozone scavenging and higher ozone during the buildup and depletion times of the day. Thus, while the peak ozone concentration may be decreasing, this reduction is being offset by increases in ozone during other hours over the 8 hour period because of NO<sub>x</sub> emission reductions. The net result is minimal changes in ozone concentrations in spite of changes in emissions.



**Figure 8.** Changes in National VOC Emissions 1970 – 2008<sup>4</sup>



**Figure 9.** Changes in National VOC Emissions 1970 – 2008<sup>5</sup>

<sup>4</sup> Colorado Department of Health and Environment, 2009, "Colorado 2008 Air Quality Report"

<sup>5</sup> Colorado Department of Health and Environment, 2009, "Colorado 2008 Air Quality Report"

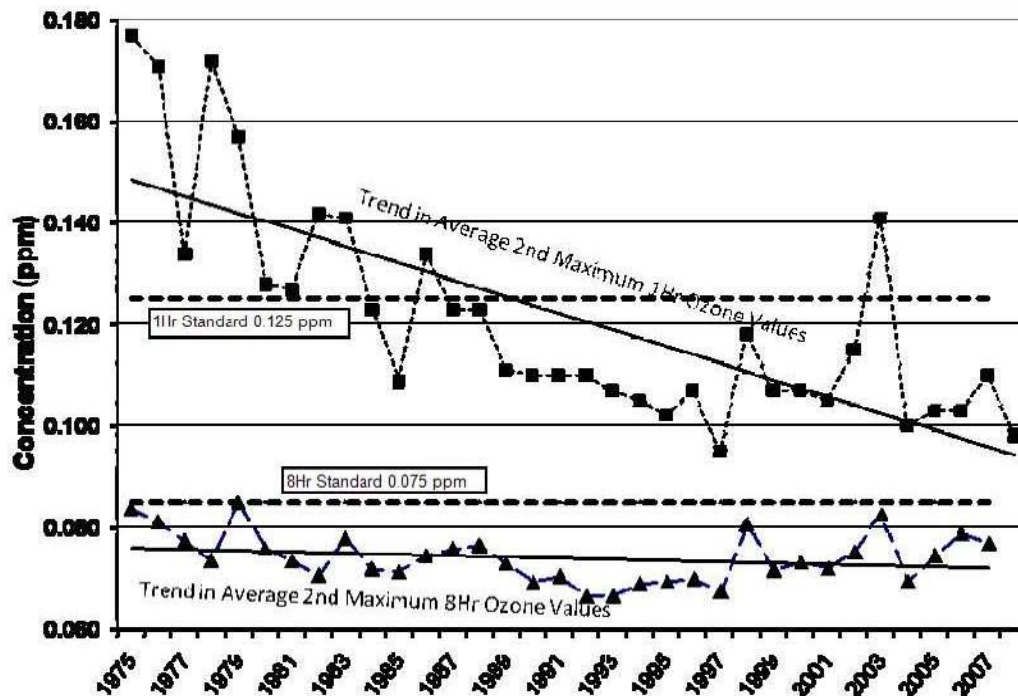


Figure 10. Changes in Colorado Air Quality Trends 1975 through 2008<sup>6</sup>

## Conclusions

As part of the standard setting process, EPA needs to:

1. Define background in an appropriate manner (U.S. anthropogenic emissions to support public health).
2. Examine the relationship between total ozone and background for specific events (background ozone paired in time with total ozone).
3. Determine if anthropogenic controls can achieve the proposed levels of the standard.
4. Recognize and disclose the importance of background in the EPA exposure and risk calculations (background importance increases as the proposed standard decreases).
5. Determine if controls needed to meet the standard are technologically feasible
6. Analyze large regions of the country with the understanding that the standard needs to be uniformly achievable for all areas.
7. Review the continued use of the 8 hour (MDA8) standard as an appropriate averaging time (because of the insensitivity of the standard to changes in emissions).

<sup>6</sup> Colorado Department of Health and Environment, 2009, "Colorado 2008 Air Quality Report"